

Formulation and proximate evaluation of barnyard millet based ice cream

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ABSTRACT

Ice cream is a delicious, nourishing frozen dairy product and a popular dessert which is preferred by all age groups. Cow's milk is the primary ingredient of dairy based ice creams which are not suitable for the population with cow's milk allergy, lactose intolerant patients and people who are following a vegan lifestyle. In the present work, we aimed to formulate a novel nutritious non-dairy ice cream with low fat and high protein content from plant based sources (barnyard millet extract, sesame extract, soy extract and coconut cream) which can be well-tolerated for consumption in lactose intolerant, obese and CVD individuals. Two different variations were prepared, variation I had barnyard, soy bean and coconut extracts (sample A,B, C) and variation II had barnyard, sesame, coconut extracts (sample D,E,F) in different proportions. All the six ice cream samples were subjected to standardization and sensory evaluation using nine points hedonic scale. According to the results of sensory attributes the samples b (7.19 ± 1.154) and e (6.59 ± 1.833) found to be highly acceptable on the basis of the overall acceptability score and evaluated for nutrient analysis. The control group was a standard soymilk-based ice cream which was used to compare with the samples A and B in triplicates. The findings of the nutrient analysis of ice cream samples conclude that the formulated ice cream in terms of content of carbohydrate, protein and fat was absolutely appropriate. The total energy value for the control sample was found to be 184.7 ± 0.05 kcal; samples A and B scored 188 ± 0.05 kcal and 168 ± 0.05 kcal respectively. The protein content of the control group was 5.09 ± 0.03 g, samples A and B were found to be 25.13 ± 0.03 g and 21.04 ± 0.03 g respectively. The fat content of the control group 10.11 ± 0.01 g was higher when compared to formulated ice cream samples. The lowest fat content of ice cream was found in sample B with 5.17 ± 0.01 g when compared to sample A of 6.05 ± 0.01 g. It can be concluded from the study that non-dairy milk alternatives have a positive influence in the host's wellbeing as it is an important source of nutrients such as proteins, vitamins, unsaturated fatty acid, antioxidant, phytochemicals, and dietary fiber and trace minerals.

KEYWORDS: Plant Extracts, Barnyard Millet, Millet Ice Cream, Lactose Intolerance

INTRODUCTION

Ice cream is a frozen dairy product made by blending and processing cream and other milk products, together with sugar and flavor with or without stabilizer or color, and with the incorporation of air during the freezing process (**Gita Bisla et al., 2012**). But it is usually considered junk food and deleterious for diabetes and heart patients due to high cholesterol, high sugar content and calorific value. Low cost, low fat, lactose free and plant-based novel ice cream formulations are the need for the hour to combat the nutritional shortcomings (**Rajkumar et al., 2016**).

The high amount of fat content in dairy based ice cream has found to elevate blood lipid ratio in a human being. The cow's milk protein allergy is one of the most extensive allergies among children and infants (**Vanga et al., 2015**). The other issues commonly associated with high consumption of cow's milk are lactose intolerance, cow's milk protein allergies, elevated cholesterol and LDL levels etc., leading to many degenerative lifestyle diseases. The replacement of cow's milk with alternative non-dairy plant-based milk is the best way to alleviate the problems related to lifestyle disease (**Goral et al., 2018**).

The non-dairy plant-based milk alternatives are considered as functional and specialty beverages across the world. In general, dissolved and disintegrated plant material suspensions are termed as plant-based milk alternatives. As an alternative to cow's milk, it can be suggested for low income groups due to its cost effectiveness (**Sethi swathi et al., 2016**).

Milletts have been observed to be high energy yielding nutritious foods with low fat and low glycemic index value which aids in addressing malnutrition and also possess various health benefits. Barnyard millet (*Echinochloa frumentacea*) comparatively contains low carbohydrate content when compared to other cereals and also possess a good amount of dietary fiber in which 8.36% of insoluble and 4.24% of soluble fraction (**Ugare roopashree et al., 2014**). In addition to the dietary fiber, barnyard millet is also a rich source of calcium, iron and other phytochemicals like antioxidants and polyphenols. The sesame seeds contain a high amount of calcium and substances present in sesame seeds like sesamol known to have a cholesterol lowering effect in humans (**Anilakumar et al., 2010**).

Soybean solids also resemble milk solids in functional properties, which are a low cost source of protein, fat, calcium and thus had a great promise as alternatives for milk solids in ice cream manufacture (**Sutar Namrata et al., 2009**). In vegan ice cream, coconut cream and cashews cream are used as fat replacers with similar sensory characteristics of a regular ice cream (**Devica R et al., 2017**). The primary objective of the current research was to formulate nutritionally balanced and palatable ice cream by incorporating barnyard millet milk, coconut milk, soy milk and sesame milk.

The specific objectives of the present study are as follows

1. To formulate and standardize a millet based ice-cream from barnyard milk, sesame milk, soy milk, and coconut milk.
2. To determine the nutrient content of the formulated ice-cream.

MATERIALS AND METHODS

The study protocol was reviewed and approved by the independent institutional ethics committee of SDNB Vaishnav College, Chennai (Ethical clearance No: SDNBVC/HSC/IHEC/2019/02)

A. PROCUREMENT OF RAW INGREDIENTS:

Barnyard millet (*Echinochloa frumentacea*), Coconut chunks (*Cocosnucifera*), Sesame seeds – black (*Sesamum indicum*L.), Soya beans (*Glycine Max*), Cocoa powder, Honey and Icing sugar were procured from the nearby local market in Chengalpet. The purchased ingredients were stored at ambient temperature for further usage during the research.

B. PREPARATION OF PLANT BASED EXTRACT:

100gms of Barnyard millet, Sesame and Soybean seeds were weighed accurately and soaked overnight at room temperature in water in the ratio of 1:3. The seeds were washed thoroughly and the excess water was drained before grinding with 400ml of water. The mixture was coarsely grinded in a mixer by pulverizing at a maximum speed for 5 minutes. The coarsely ground mixture was filtered using a double layered muslin cloth to obtain milk extracts. The extracts were double boiled for 5mins with constant stirring.

C. PREPARATION OF COCONUT CREAM:

The hard woody outer shell of the coconut was broken, fresh coconut meat was extruded, chopped into fine pieces, ground into fine paste in a mixer to extract coconut milk and refrigerated overnight. The thick creamy layer of fat was separated and used in the preparation of the plant based ice-cream.

D. DEVELOPMENT AND STANDARDIZATION OF MILLET BASED ICE CREAM

The extracted thick creamy layer of coconut milk was beaten with icing sugar. The honey and cocoa powder was added to the mixture and beaten again. The extracts of barnyard and soybean was added and churned for 30 minutes in an ice cream maker machine. The same processing procedure was repeated for the other variation with the extracts of barnyard and sesame seeds were mixed with the cream and then churned for 30 minutes in an ice cream maker machine. The prepared plant based ice cream mix was allowed to set for four hours in the refrigerator

and served cool. Soybean ice cream was used as control and it was prepared using preparatory method used in the formulation study by **Sutar Namrata et al., 2010**.

E. VARIATIONS

TABLE 1
PROPORTIONS OF DIFFERENT VARIATIONS OF MILLET BASED ICE CREAM

INGREDIENTS	VARIATION I			VARIATION II		
	A	B	C	D	E	F
Barnyard millet milk (ml)	30	40	30	30	40	30
Coconut milk (ml)	40	30	30	40	30	30
Soy milk (ml)	30	30	40	-	-	-
Sesame milk (ml)	-	-	-	30	30	40
Icing sugar (g)	50	50	50	50	50	50
Honey (ml)	50	50	50	50	50	50
Cocoa powder (g)	5	5	5	5	5	5
Total	205	205	205	205	205	205

F. NUTRIENT ANALYSIS:

Nutrient analysis was done using standard methods of AOAC in triplicates for the formulated plant based ice cream samples (B & E) which was highly acceptable by sensory evaluation and compared with control group.

G. STATISTICAL ANALYSIS

The statistical analysis of mean and standard deviation was done.

RESULTS AND DISCUSSION:

NUTRIENT ANALYSIS:

In the formulated plant based ice cream samples A and B and control, the proximal attributes such as ash, moisture, energy, carbohydrate, protein, fat, calcium and phosphorous were analyzed and exhibited in Table 1

TABLE 2 NUTRIENT ANALYSIS

S.NO	PROPERTIES	CONTROL	SAMPLE A	SAMPLE B
1.	Ash (%)	0.52± 0.01	0.49± 0.01	0.43± 0.01
2.	Moisture (%)	65.93± 0.98	53.62±0.50	61.31±0.30
3.	Energy (kcal)	184.71±0.05	188±0.05	168.2±0.05
4.	Carbohydrate (g)	18.34±0.01	8.13±0.01	9.34± 0.01
5.	Protein (g)	5.09± 0.03	25.13± 0.03	21.04± 0.03
6.	Fat (g)	10.11± 0.01	6.05± 0.01	5.17± 0.01
7.	Calcium (mg)	25±0.01	38.10±0.01	39.05±0.01
8.	Phosphorous (mg)	32±0.02	10.33±0.05	12.44±0.04

A. ASH

The ash is an inorganic deposit obtained after the removal of water and organic matter by heating in the presence of oxidizing agents. The ash content present in the samples accounts to the total amount of mineral in the food (Ashan et al., 2015). The result of the ash value showed no difference in the control and test samples.

B. MOISTURE

The moisture content of food is defined as the amount of water present in the food product. It affects the appearance, texture, taste, weight and shelf life of the food products. Even the slight changes of the moisture content can bring about deteriorative changes in the physical and chemical aspects of the food product. The nutritive analyses of the present study shows that the moisture content of control ice cream is 65.93±0.98% which was found to be higher than the samples A and B which is 53.62±0.50% and 61.31±0.30% respectively. The results are in line

with the findings of **Namrata Sutar 2009** which ranges from 65.18 to 68.53. The moisture content of sample B is almost nearby the value found in the sesame ice cream as reported by **Abdallwahab 2017**.

C. ENERGY:

The total energy value for the control sample was found to be 184.7 ± 0.05 kcal. The energy value of sample A scored the highest value (188 ± 0.05 kcal) and the sample B had showed the lowest value (168 ± 0.05 kcal) among all the analyzed samples. The results revealed that the total energy obtained from the samples were considerably lower than cow's milk based ice cream. Thus the ice cream samples formulated were low in calories which make it suitable for consumption for general population opting for low calorie desserts.

D. CARBOHYDRATE:

The carbohydrate content of the control ice cream sample was found to be 18.34 ± 0.01 g which was two folds higher than the formulated ice cream samples A and B. The carbohydrate content of both the variation A and B was found to be 8.13 ± 0.01 g and 9.3 ± 0.01 g. The carbohydrate values of the samples A and B (14.83 to 20.26%) was lower than the soya bean ice cream formulated by **Namrata Sutar, 2009**. The obtained result conveys that the low carbohydrate content of ice cream makes it suitable for health conscious consumers.

E. PROTEIN:

The result exhibited that the protein content of the control ice cream is lower than the plant based ice cream formulated ice cream. The protein content of control group ice cream was found to be 5.09 ± 0.03 g. The protein content of sample A (25.13 ± 0.03 g) was higher than protein content of sample B (21.04 ± 0.03 g). The high protein content of ice cream sample A is due to high protein found in the soybean extracts. **Bisla et al., 2012 and Abdullah et al., 2003** stated that soymilk protein content is higher than the cow's milk. The protein content of sample B is higher than sesame ice cream (9.3g) as reported by **Abdallwahab, 2017**.

F. FAT:

The fat content of plant based ice cream ranged from 5.17g to 10.11g. The fat content of control group (10.11 ± 0.01 g) was found to be higher in all the ice cream samples. The lowest fat content of ice cream was observed in sample B with 5.17 ± 0.01 g and sample A with 6.05 ± 0.01 g. The fat content of the samples A and B was lower than the control soybean ice cream which ranged from 10.11 to 10.85% . The values of the samples A and B are similar to the fat content of ragi ice cream (5.84g to 6.54g) as reported by **Patel, 2014**.

G. CALCIUM AND PHOSPHORUS

The result reveals that the calcium content of control ice cream was found to be 25 ± 0.01 mg and it was found to be lower than the other samples. The calcium content of sample B is 39.05 ± 0.01 mg which is slightly higher than the sample A (38.10 ± 0.01 mg). Both the variations A and B have high calcium content due to addition of soybean and sesame extract (975 mg/100gm of calcium). The phosphorous content of control sample was found to be 32 ± 0.02 mg. The phosphorous content of the sample A (10.33 ± 0.05 mg) and B (12.44 ± 0.04 mg) is lower than the control sample. The processing techniques such as soaking, grinding and filtration had considerable effect the mineral content of the samples (Nazini et al., 2016).

CONCLUSION

The findings of the proximate analysis of the formulated plant based ice cream concludes that the ice cream possessed appreciable amount of carbohydrate, protein, fat, calcium and phosphorous. Furthermore, the results of the sensory evaluation showed that the ice cream formulated with banyard, soyabean and coconut extract had showed the better acceptability score when compared with the ice cream formulated with variation of barnyard, sesame and coconut extracts. The formulated plant based non - dairy ice cream can be consumed by population suffering from lactose intolerance, cow's milk protein allergy and consumers following vegan diet in future. Moreover this ice cream also has potential for commercialization in future. Thus the findings of the study will aid in the design and optimization of an acceptable millet based ice cream.

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